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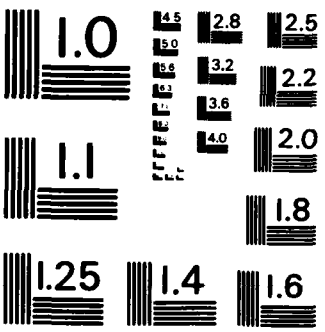

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Power conditioning, pulsed power, glow discharge physics, hydrogen thyratrons, thyratrons, glow discharge switches, high power switching, cathodes, switch physics, opening switches, optical energy extraction, laser induced fluorescence, plasmas, partially ionized gases.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The research porgram sought to analyze in a very quantitative way the high current glow discharge for hydrogen, and other gases that are of interest for optogalvanic opening switches, thyratrons, and for other areas of high power switching. The work developed quantitative models, and this analysis, based on theory and experiment, provides a body of basic knoweldge to be used for switch development and other applications. The program addressed properties of the bulk plasma including transport, the electron distribution function, the

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populations of specific excited states, and device development. This is needed for the development of a new and different generation of gas phase devices, and thus will be especially useful as device concepts are developed that are based on energy transfer processes involving specific quantum states, such as light assisted opening switches and other optogalvanic devices. Further, the development of optical diagnostic methods will provide an important additional benefit to DoD laboratory research. We think that this quantitative approach offers the highest probability for payoff in terms of new devices based on new concepts.

FINAL REPORT

MARTIN A. GUNDERSEN

JULY 5, 1982 - JULY 4, 1985

U.S. ARMY RESEARCH OFFICE

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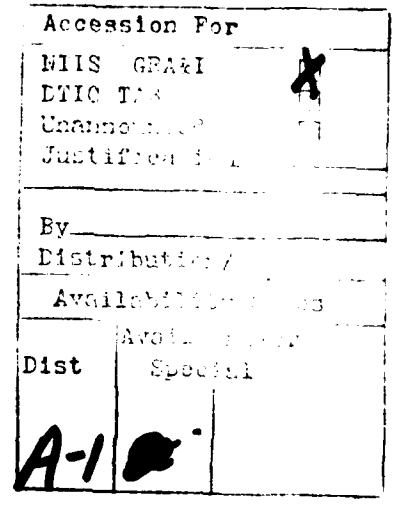

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TABLE OF CONTENTS

		Page No.
I.	STATEMENT OF PROBLEMS STUDIED	1
II.	SCIENTIFIC PERSONNEL	1
III.	ACCOMPLISHMENTS	2
IV.	LIST OF MANUSCRIPTS SUBMITTED OR PUBLISHED UNDER ARO SPONSORSHIP DURING THESE PERIODS, INCLUDING JOURNAL REFERENCES	3
V.	INTERACTIONS	10
	V.1. Talks Presented	10
	V.2. Other Interactions	13

I. STATEMENT OF PROBLEMS STUDIED

The research program sought to analyze in a very quantitative way the high current glow discharge for hydrogen, and other gases that are of interest for optogalvanic opening switches, thyratrons, and for other areas of high power switching. The work developed quantitative models, and this analysis, based on theory and experiment, provides a body of basic knowledge to be used for switch development and other applications. The program addressed properties of the bulk plasma including transport, the electron distribution function, the populations of specific excited states, and device development. This is needed for the development of a new and different generation of gas phase devices, and thus will be especially useful as device concepts are developed that are based on energy transfer processes involving specific quantum states, such as light assisted opening switches and other optogalvanic devices. Further, the development of optical diagnostic methods will provide an important additional benefit to DoD laboratory research. We think that this quantitative approach offers the highest probability for payoff in terms of new devices based on new concepts.

II. SCIENTIFIC PERSONNEL

Martin A. Gundersen
Joseph A. Kunc
Shekhar Guha
Daniel Erwin
Christopher Braun
Hong Hai Dai

III. ACCOMPLISHMENTS

The following accomplishments are of importance to DoD programs:

1. The theory of the glow-discharge switch, which we have developed for the steady-state phase of the hydrogen thyratron.

2. Calculated rate coefficients that are useful for high current hydrogen discharge calculations.

3. We have successfully demonstrated that laser induced fluorescence can be used in a thyratron operating at high power (current above 100 A/cm^2). We are in the process of determining populations of excited states of atomic hydrogen.

4. Developed a method of measuring electron temperatures in the thyratron discharge.

5. Determined pertinent transport coefficients (diffusion, mobility, conductivity) in the thyratron-type glow discharge.

6. Developed a model from experimental data for a new field emission cathode. This cathode is very important for high current switches.

7. Operated thyratrons with helium. The properties of helium in the thyratron are important for the development of improved high power switches. We have observed a more rapid recovery using helium.

8. Presented a new theory describing the interaction between two fields and three levels with arbitrary 1) frequency mismatches, 2) lifetimes, and 3) field strengths.

9. Completed a paper describing in detail the production of radiation in a thyratron plasma.

10. Developed a fairly general model that accounts for coulomb collisions in high current plasmas.

These are described in detail in the publications.

IV. LIST OF MANUSCRIPTS SUBMITTED OR PUBLISHED UNDER ARO SPONSORSHIP DURING THESE PERIODS, INCLUDING JOURNAL REFERENCES:

(1982)

"Optical processes in laser-controlled Gas Phase Switches," M.A. Gundersen, Electro-Optic System Design, 25, June 1982.

Abstract: The laser has considerable potential for new applications in switching, and several optical processes are promising as techniques for switch control.

"Tunable Pump Laser Stabilization of the CF_4 Laser," M.A. Gundersen and T.A. Yocom, IEEE J. Quantum Electron., QE-18, 1237 (1982).

Abstract: This paper reports a study of tunable laser-pump requirements for stable optically pumped CF_4 operation. Using an extremely precise method of measurement, the width of the absorption feature associated with lasing was determined. The results demonstrate the feature to be extremely narrow (~ 15 MHz in our optical configuration) and provide constraints on the tunable pump laser that must be included in the design of an efficent optically pumped laser system.

"A Study of Discharge Processes in Hydrogen Thyratrons," S. Guha, H. Cole, and M.A. Gundersen, IEEE Trans. Plasma Sci. PS-10, 309 (1982).

Abstract: The purpose of this paper is to provide a discussion of the fundamental processes occurring in hydrogen thyratrons. Recent experimental data pertaining to electron densities, energies, and excitation processes occurring in devices during their normal operation are presented. Electron densities are observed to be lower than 2×10^{14} cm^{-3}, corresponding to current densities of approximately 100 A/cm^2. The presence of both molecular and atomic species affecting recovery and voltage reerection is reported, and mechanisms for this are discussed. Streak camera data showing a delay in breakdown of the grid-anode relative to the grid-cathode region are also presented.

"Plasma Parameters Characteristic of Hydrogen Thyratrons under Steady-state Conditions," J.A. Kunc and M.A. Gundersen, IEEE Trans. Plasma Sci. PS-10, 315 (1982).

Abstract: This paper presents an analysis of the plasma occurring during the steady-state phase in a hydrogen thyratron.

(1983)

"Scalar Transport Coefficients for the Hydrogen Plasma in the Cathodegrid Region of a Thyratron," J. Kunc and M. Gundersen, J. Appl. Phys. 54, 2761 (1983).

Abstract: The scalar conductivity, electron diffusion coefficient and mobility have been calculated for a hydrogen plasma in the cathode-grid region of a hydrogen thyratron, assuming neutral pressure about 0.5 Torr, electron temperature 1 eV, electron density $N_e \simeq 10^{14}$, and electric field E_p = 5 - 10 V/cm. The role of coulomb collisions is considered, and it is shown that coulomb collisions are important in the plasma.

"Field Emission Cathode," R. Petr and M. Gundersen, Laser and Particle Beams 1, 207 (1983).

Abstract: Field emission is identified as the mechanism responsible for high current emission (50 A/cm^2 at 300^{o}K) from a dispenser-type cathode. This cathode has advantages for high power operation, and should be suitable for practical applications.

"A Fundamental Theory for High Power Thyratrons I: The Electron Temperature," J. Kunc, S. Guha, and M.A. Gundersen, Laser and Particle Beams 1, 395 (1983).

Abstract: This paper is a part of a series that is de elop ng a detailed understanding of the physics hydrogen thyratrons. This theory is needed because the improvement of electrical switches such as the thyratron are now necessary for the development of high power lasers and other devices. In this paper, a detailed analysis of many different electron, atomic and molecular collisional and radiative processes is made, in order to determine the electron temperature in a thyratron plasma. Calculations of the rates of excitation of Balmer levels are made, and the results are summarized in a way that can be used for in situ measurements.

"A Fundamental Theory for High Power Thyratrons II: The Production of Atomic Hydrogen and Positive Ions," J.A. Kunc and M.A. Gundersen, Laser and Particle Beams 1, 407 (1983).

Abstract: The production of atomic hydrogen and positive ions in a typical hydrogen thyratron plasma is considered through an analysis of radiative and collisional processes.

"The Transient and Steady State Interaction of Two Fields with a Three Level System," S. Guha and M.A. Gundersen, Phys. Rev. A, submitted.

Abstract: The interaction of two electric fields with a three level homogeneously broadened atomic or molecular system, having in general unequal lifetimes for the three levels, is studied using the semi-classical density matrix formalism. The transient and steady state situations are considered. Arbitrary mismatches of the optical fields with the transition frequencies. The special case when one of the fields is static is also considered. Numerical results for the susceptibility are presented for two electric fields interacting with the three lowest electronic states i the triplet system of molecular hydrogen.

"A Review of Some Recent Thyratron Developments," J.A. Kunc, S. Guha, C. Braun, D. Erwin, and M.A. Gundersen, Proceedings, IV IEEE Pulsed Power Conference, p. 133, June 1983.

Abstract: A short review of a basic research program at USC directed towards developing an understanding of fundamental processes in thyratrons is presented. The importance of the production of atomic hydrogen, and a method to measure the electron temperature in hydrogen thyratron is discussed. It has been found that the electron distribution function is nearly Maxwellian, and the degree of ionization is about 0.1. Several other findings of the properties of the plasma and transport coefficients are included. Results of a study of helium as a thyratron gas are presented.

"Metastable Quenching by Optical Pumping," S. Guha, J. Kunc, C. Braun, and M.A. Gundersen, Proceedings, IV IEEE Pulsed Power Conference, p. 723, June 1983.

Abstract: A theoretical study of the quenching of the metastable states in hydrogen by optical coupling to energetically close radiative states is presented. The dependence of the metastable lifetime on the intensity and frequency of the optical radiation is determined. The advantages of using an optical field over static electric field are described. Applications to optically controlled switches, and in particular, the effect of controlling metastable populations are discussed.

"Rate Coefficients for Some Collisional Processes in High-current Hydrogen Discharges," D.A. Erwin and J.A. Kunc, IEEE Trans. Plasma Sci., in press.

Abstract: Rate coefficients are presented for a number of collisional processes important in high-current hydrogen discharges. The coefficients are expected to be useful in studying the physics of thyratrons and other gas-phase switches.

"High Voltage Diagnostics: An Experimental and Theoretical Approach," J.A. Kunc and M.A. Gundersen, Proceedings of the 1983 NATO Meeting on Fast Optical and Electrical Diagnostics.

Abstract: This paper discusses an approach to high voltage diagnostics for gas phase applications. This approach uses an analysis of collisional and radiative processes along with spectroscopic data to obtain microscopic parameters, such as mobility, electron density and fields. As an example the electron distribution function in a hydrogen plasma characteristic of a hydrogen thyratron is considered. It is shown that the electron temperature may be determined from the ratio of Balmer emission intensities, but only after properly considering the non-equilibrium character of the atomic excited states. It is argued that the analysis of microscopic processes, along with experimental data, are necessary for the development of proper diagnostic methods for discharge devices.

"Summary of the 1983 Workshop on Thyratron Problems," M. Gundersen.

The workshop on the state-of-the-art of hydrogen thyratrons was held Thursday, June 9, 1983, at the Air Force Weapons Laboratory. Organizers of the workshop included Tom Burkes, Ed Chu, Martin Gundersen, Steve Levy, James O'laughlin, Glen McDuff and Dave Turnquist. The workshop was supported by Hughes Aircraft Company and Los Alamos National Laboratory.

(1984)

"Optical Quenching and Energy Extraction Involving Metastable and Dissociative States in Hydrogen," S. Guha, J.A. Kunc, and M.A. Gundersen, IEEE J. of Quantum Electr. **QE-20**, 504, (1984).

Abstract: Optical quenching of metastable molecular species and the generation of tunable broad-band stimulated emission in the UV is considered for molecular hydrogen. A detailed theoretical analysis is summarized and a study of the optical energy extraction process, using off-resonant optical pumping from the metastable state $c^3{}_u$ to the dissociative continuum state $b^3{}^+_u$ is presented. Earlier experimental work is discussed, and numerical results for the case fo off-resonant pumping are presented.

"Modeling of Plasma Devices for Pulsed Power," J.A. Kunc and M.A. Gundersen, Appl. Phys. Lett. **45**, 31 (1984).

Abstract: This letter considers quantitative models of microscopic processes in plasmas formed in gas phase devices for pulsed power. Although models have been developed for devices such as lasers, there are others, such as switches, where these processes have been treated only phenomenologically. Further, transport data must be adjusted to include the effects of high electron density. It is shown that it is necessary to use a microscopic model to correctly describe the device behavior. Examples presented include the effect of Coulomb collisions on conductivity in various gases, and the ionization processes in a hydrogen thyratron.

"Gas-Discharge Devices for High-Power High-Repetition Applications: A Basic Approach," J.A. Kunc, C. Braun, D. Erwin, and M.A. Gundersen, Digest of Technical Papers, 16th Power Modulator Symposium, 1984.

Abstract: It is of paramount importance to understand the fundamental processes in devices such as high power gas phase switches. Presently, there is only a limited, phenomenological understanding of such processes. Further, there is a lack of communication between scientists with skills in this area of research, and engineers with switching experience. It is clear that a fundamental understanding of "switch physics" is desirable if significant improvements are to be made, and if radically different approaches are to be considered, such as exploiting the optogalvanic effects. In this paper, a discussion of our research is presented. Following this, some suggestions are presented pertaining to the role of basic research in switch development.

"A Fundamental Theory for High Power Thyratrons III: The Production of Radiation," J.A. Kunc, D.E. Shemansky, and M.A. Gundersen, Laser and Particle Beams **2**, 129 (1984).

Abstract: The radiation characteristics of a high-current hydrogen thyratron plasma have been modeled in order to study this aspect of the physics of the conductive phase of thyratron operation. The intensities and radiative energy efficiencies of the atomic and molecular systems have been calculated in detail. A model is developed that is useful for studies of photoemission. For discharge parameters $T_e \simeq 1$ eV, ionization fraction of $\sim 10^{-2}$ and brackground density of 10^{16} cm^{-3}, the total power of the emitted radiation is estimated to be of the order of 5% of the total input power during the conductive phase.

"Analytical Expressions for H^+, H_2^+, and H_3^+ Ion Densities in a Hydrogen Glow Discharge," J.A. Kunc and M.A. Gundersen, Physics Fluids **27**, 2862 (1984).

Abstract: Simple analytical formulae for positive ion densities in high-current, medium-pressure (or order 1 mm Hg) steady-state hydrogen discharges have been obtained. These plasmas have a medium to high degree of ionization ($>10^{-4}$), electron temperature on the order of 1 eV, and are typical of those that occur in hydrogen thyratrons and glow discharges switches. It is found that the role of charge exchange ($H^+ + H_2 \quad H_2^+ + H$) may be significant, and limits for the effect of this process in ion production are estimated.

"Contribution of Dissociative Processes in the Production of Atomic Lines in Hydrogen Plasmas," J.A. Kunc, J. Quantitative Spectros. and Rad. Transf., in press.

Abstract: The contribution of molecular dissociative processes in production of atomic lines in steady-state hydrogen plasma (containing both molecules and atoms) is considered. If the contribution of the dissociative processes is dominant in production of an atomic line in the plasma, a substantial reduction of efforts in diagnostic of the plasma can be achieved. Numerical calculations have been performed for the production of Balmer alpha, beta and gamma lines in hydrogen plasmas with medium and large degrees of ionization ($x \gtrsim 10^{-4}$) and with 5000° K $\lesssim T_e \lesssim 45000^{\circ}$ K and 10^{10} cm$^{-3} \lesssim N_e \lesssim 10^{16}$ cm^{-3}.

"Diffuse Discharge Switches," M.A. Gundersen, R. DeWitt, S. Friedman, R. Harvey, G. McDuff, D.V. Turnquist, and W. Wright, Chapter in the 1984 Workshop on Foreign Switch Technology, p. 195 (Sept. 26, 1984). Copies available through Scientific Services Program, U.S. Army Research Office.

Abstract: This committee considered low pressure devices -- 100 microns < P < 100 Torr. This regime includes primarily thyratrons, hydrogen tacitrons, and cesium tacitrons. The Russian technology is mature in this area, and is clearly more advanced int he area of tacitrons. They have developed commercial tacitrons, and we have not. These are used for applications, probably including agile radar, satellite power, and radiation hardened aircraft. There are indications of tubes for military applications (graded grid thyratrons, for example), but no data on these. The primary U.S. deficiencies are 1) in level of research effort, 2) lack of long term research, and 3) lack of device development through long term effort. These are deficiencies that can be remedied if there is intelligent administration of research. The major research areas that should be advanced are 1) basic phenomena associated with switching, 2) new, blue sky concepts ith promise to provide technological breakthrough, and 3) viable older but undeveloped concepts such as tacitron types of devices.

"Conductivity of Weakly and Highly Ionized Gases in Quasistatic Electric Fields," J.A. Kunc, Phys. Fluids **27**, 2859 (1984).

Abstract: Simple and accurate expressions for electric conductivity in steady-state weakly and highly ionized plasmas are presented. These expressions give good agreement with exact "4x4 matrix formulation" numerical calculations. The plasmas are assumed to be isotropic, i.e., the applied magnetic field is neglected. The applied electric field is either static (dc) or of low frequency.

"Thyratron Operation Using Helium for High-Power and High-Repetition Rate Applications," S. Guha, C. Braun, J.A. Kunc, and M.A. Gundersen, IEEE Trans. on Electron Dev. **ED-31**, 992 (1984).

Abstract: Results of a study of the helium thyratron for high-power applications are reported. The helium thyratron operates at high voltages and currents, comparable to hydrogen, and, for certain of the conditions studied, recovers faster than hydrogen. These results suggest that helium thyratrons should be seriously considered for high-power applications, such as excimer lasers.

(1985)

"Fundamental Processes in High Current Glow Discharge Switches," M.A. Gundersen, J.A. Kunc, D. Erwin, and Chris Braun, Fifth IEEE Pulsed Power Conference, June 10-12, 1985.

Abstract: A review of USC research is presented. Results include new understanding of transport, ionization, and other processes that determine device behavior. Applications include providing a basis for the development of predictive models for new devices. A review of evidence for the formation of a 1 eV, Maxwellian electron distribution in a hydrogen thyratron is presented.

"Plasma Diagnostics using Laser-Induced Fluorescence," D.A. Erwin and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985.

Abstract: The application of laser-induced fluorescence to the study of switch plasmas is discussed. A short-pulse (5 ns) technique is described, and experimental results given for a hydrogen thyratron plasma ($T_e \sim 10000^oK$, $J \sim 100\text{-}200\ A/cm^2$), using the Balmer beta line for pumping. The technique is shown to be a useful time-resolved tool for measuring lower-level populations and upper-level decay rates during a thyratron pulse.

"A Comprehensive Microcomputer Based Data Acquisition System for Pulse Power Research," C. Braun, E. Bak, J. De Barros, P. Cheung, and J. Andras, Fifth IEEE Pulsed Power Conference, June 10-12, 1985.

Abstract: Our approach to the ubiquitous problem of interfacing the computer to the laboratory was to create a modular set of programs forming a support environment (e.g. plotter, data editor, filer) to which any number of interfacing modules can be added as required. A general method that handles many different data formats is presented. The software is written in HP pascal and runs on HP series 200 computers. More than thirteen devices are interfaced, both software and hardware, including a Tektronix 7912AD transient digitizer, a PARC optical multi-channel analyzer, and a Hamamatsu streak camera. This integrated computer system provides the infrastructure to coordinate and control complex experiments and to acquire, transform and plot data. Specific applications to problems including diagnostics of switch plasmas are described.

"A Theoretical and Experimental Study of High Current Discharges in Argon," C. Braun, J. Kunc, and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985.

Abstract: A theoretical model for a steady state argon plasma characteristic of a high power device is presented, along with experimental data. Applications to devices are considered. The development and application of spectroscopic experimental techniques are described. Conditions under which the electron distribution function deviates from Maxwellian are delineated. The model is based on the microscopic processes in the plasma, and this is important, because it provides a fundamental basis for determining the limiting behavior of real devices. The plasma is modeled with a Boltzmann equation that includes inelastic collisions, and is coupled to a three level rate equation.

"Intrinsic Relationships between Current and Plasma Quantities in Thyratrons," D.A. Erwin, J.A. Kunc, and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985.

Abstract: A model for the conductivity in a thyratron plasma is presented. Experimental and theoretical data are given which lead to relationships between the current density and the electron density, electron temperature and electric field under high-current conditions in a hydrogen thyratron.

V. INTERACTIONS

V.1. Talks Presented:

"Fundamental Properties of Hydrogen Thyratrons," Naval Surface Weapons Center, Dahlgren, VA, February 17, 1982.

"Pulsed Power at USC," Texas Tech Pulsed Power Review, May 19, 1982.

"Basic Research in Hydrogen Thyratrons," presented at Math Sciences Northwest, Seattle, WA, July 20, 1982.

"Optical Energy Extraction," Workshop on Optically Controlled Diffuse Discharge Switches, Eugene, Oregon, December 2, 1982.

"Fundamental Processes in Hydrogen Thyratrons," Fifteenth Power Modulator Symposium, June 14, 1982, with S. Guha, H. Cole, and J. Kunc.

"Plasma Processes in Hydrogen Thyratron," 35th Gaseous Electronics Conference, October 19, 1982, with J.A. Kunc and S. Guha.

"Electronic Cross Section for Excitons Bound to ZnO Pairs in GaP," with P.G. Snyder and C.W. Myles, presented to the March 1983 APS Meeting, Bull. Am. Phys. Soc. **28**, 413 (1983).

"A New Radiative Recombination in GaP," with P.G. Snyder, presented to the 1983 March APS Meeting, Bull. Am. Phys. Soc. **28**, 413 (1983).

"Pulsed Power Physics," 1983 Industrial Associates Research Review, May 12, 1983.

"Fundamental Processes in Thyratrons," with J.A. Kunc and S. Guha, Electron-Tubes, Nachrichtentechnische Gesellschaft im Verband Deutscher Elektrotechniker, Garmish-Partenkirchen, May 18-10, 1983.

"A Theoretical Study of Steady-State Properties of a High-Current Hydrogen Discharge," with J.A. Kunc, presented to the 1983 IEEE Plasma Science Meeting, May 1983.

"Recent Thyratron Research," with J.A. Kunc, S. Guha, C. Braun, and D. Erwin, IV IEEE Pulsed Power Conference, Albuquerque, NM, June 6, 1983.

"Metastable Quenching by Optical Pumping," with S. Guha, J.A. Kunc, and C. Braun, IV IEEE Pulsed Power Conference, Albuquerque, NM, June 8, 1983.

"A Spectroscopic Approach to Fast Optical Diagnostics," M.A. Gundersen, presented to the NATO Advanced Study Institute Meetings, Castelvechhio Pascoli, Italy, July 10 - 24, 1983.

Presented a talk on thyratron research to the State University of New York Buffalo on October 12, 1983, "A study of the plasma in a hydrogen thyratron."

"Spectroscopic Methods for High-Voltage Diagnostics," presented to the 1983 High Voltage Workshop, Harry Diamond Labs, Adelphi, Maryland, October 4 - 6, 1983.

"Formation of H^+, H_2^+, and H_3^+ in a Molecular Hydrogen Plasma with High Ionization Degree," J.A. Kunc and M.A. Gundersen, prsented to the 36th Gaseous Electronic Conference, Albany, New York, October 11 - 14, 1983.

"Efficiencies of Some Collisional Processes in Hydrogen Discharges," D.A. Erwin and J.A. Kunc, presented to the 1983 IEEE Plasma Sciences Conference.

"Optical Energy Extraction in Molecular Hydrogen," S. Guha and M. Gundersen, presented at the 1983 Annual Meeting of the Optical Society of America, New Orleans, Louisiana, October 16 - 22, 1983.

"Transient Interaction of Two Electric Fields with a Three Level System," S. Guha and M. Gundersen, presented at the 1983 Annual Meeting of the Optical Society of America, New Orleans, Louisiana, October 16 - 22, 1983.

"Molecular Dissociative Processes in the Productiion of Atomic Emission in a Non-Equilibrium Hydrogen Plasma," J.A. Kunc and M.A. Gundersen, 1984 IEEE International Conference on Plasma Science, May 14-16, 1984, St. Louis, MO.

"Gas Discharge Devices for High-Power High-Repetition Rate Applications: A Basic Approach," J.A. Kunc, C. Braun, D. Erwin, and M.A. Gundersen, 1984 16th Power Modulator Symposium, June 18-20, 1984, Washington, D.C.

"Analytical Solutions for a Transient Two-Field Three-Level System with Arbitrary Lifetimes," S. Guha and M.A. Gundersen, 1984 OSA Meeting, Oct. 29 - Nov. 2, 1984, San Diego, CA.

"Recent Advances in Thyratrons and Glow Discharge Switches," M.A. Gundersen, Seminar, April 8, 1985, Massachusett Institute of Technology.

"Fundamental Processes in High Current Glow Discharge Switches," M.A. Gundersen, J.A. Kunc, D. Erwin and C. Braun, Fifth IEEE Pulsed Power Conference, June 10-12, 1985, Washington, D.C.

"Plasma Diagnostics using Laser-Induced Fluorescence," D.A Erwin and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985, Washington, D.C.

"A Comprehensive Microcomputer Based Data Acquisition System for Pulse Power Research," C. Braun, E. Bak, J. De Barros, P. Cheung, and J. Andras, Fifth IEEE Pulsed Power Conference, June 10-12, 1985, Washington, D.C.

"A Theoretical and Experimental Study of High Current Discharges in Argon," C. Braun, J. Kunc, and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985, Washington, D.C.

"Intrinsic Relationships between Current and Plasma Quantities in Thyratrons," D.A. Erwin, J.A. Kunc, and M.A. Gundersen, Fifth IEEE Pulsed Power Conference, June 10-12, 1985, Washington, D.C.

"Collisional-Radiation Coefficients from a Three-level Atomic Model in Argon Plasmas," C. Braun and J.A. Kunc, NATO ASI Workshop, June 23 - July 5, 1985, Pitlochry, Scotland.

"Plasma Radiation Fundamentals," J.A. Kunc, NATO ASI Workshop, June 23 - July 5, 1985, Pitlochry, Scotland.

"Plasma Diagnostics using Laser Induced Fluorescence," D.A. Erwin and M.A. Gundersen, NATO ASI Workshop, June 23 - July 5, 1985, Pitlochry, Scotland.

Laser-Induced Fluorescence Diagnostics in High-Current Glow Discharge Plasmas," D. Erwin and M.A. Gundersen, 18th Annual Gaseous Electronics Conference, Monterey California, October 15-18, 1985.

V.2. Other Interactions

Visit to Air Force Weapons Laboratory, Shiva and Trestle programs.

Helped arrange for Engineering students to visit White Sands Missile Range, Yuma, and Fort Huachucha. This trip was organized by Major General Koehler (WSMR) and Lt. Col. Knapp (USC).

Presented a talk on DoD research at USC to the Defense Contract Regional Administrative Officers meeting at USC.

I ran a Workshop on the state-of-the-art of Thyratrons, June 9, 1983, at the Air Force Weapons Laboratory. About 30 people attended, and a summary is included in the papers.

Technical interactions with the U.S. Army ERADCOM, Ft. Monmouth, New Jersey, Steve Levy, et al.; Naval Surface Weapons Center, Larry Leussen, Frank Rose, Robert DeWitt; Lawrence Livermore National Laboratory, Earl Ault, Don Ball, Randall Ross; Air Force Weapons Laboratory, A.H. Guenther; ITT Electron Tube Division, Henry Grunwald; Los Alamos National Laboratory, Glen McDuff, C. Randy Jones, Steve Rockwood; EG&G, Inc., Steve Friedman; Maxwell Laboratories, Ed Chu; Physics International, Alan Toeppfer; Impulse Electronics, Dave Turnquist; Mathematical Sciences Northwest, Rodney Petr and Stan Byron.

I have written parts of an assessment of Soviet Switch technology for T.R. Burkes, Inc. My work included contributions to the sections on solid state switches and thyratrons.

Workshop on Soviet Switch Technology, Santa Fe, N.M., March 6-8, 1984.

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